TRANSIT PERFORMANCE REVIEW GUIDELINES

PART THREE - TRANSPORTATION OPERATIONS, EQUIPMENT AND PLANT MAINTENANCE

JANUARY, 1984

Ontario
Ministry of
Transportation and
Communications

Ontario
Urban
Transit
Association

FOREWORD - PART THREE

This is Part Three of the Transit Performance Review Guidelines produced by the Ontario Urban Transit Association and the Ontario Ministry of Transportation and Communications, through their Transit Productivity Committee. The Committee includes representatives of transit management and Ministry staff. Its objective is to assist all Ontario transit systems to maximize the effectiveness and efficiency with which they fulfill their responsibilities to their local communities.

The contents of the Guidelines are given in the index which follows. In summary:

- Part One provides an introduction and background on the purpose of the Guidelines. It also describes the approach and the steps in the performance review process. As such, Part One should be referred to when using Parts Two or Three.

- Part Two deals with performance in general management, administration, strategic decision-making and planning. These activities determine the overall resources in manpower and equipment needed to run a transit system.

- Part Three covers performance in the day-to-day operation of the system that relate to the assignment of operators and vehicles to service on the street and to the maintenance of equipment and plant.

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6 TRANSPORTATION OPERATIONS

Transportation operations involves the delivery of operating personnel and vehicles to meet the requirements of the service plan, according to the work rules established through the collective bargaining process. These activities account for over two thirds of operating costs and, therefore, the efficiency of transportation operations is crucial to the overall performance of the transit system.

This chapter covers those activities which influence the performance of transportation operations, and sets out the information sources and review procedures for evaluating this performance. These activities are:

- o Labour Operations - daily operating activities of operators
- o Scheduling - run cutting and planned assignment of operators and vehicles
- o Dispatching - daily assignment of operators and vehicles
- o Supervision - supervision of the service on the street
- o Transit Control - handling of emergency incidents

The main requirement of the operations function is to provide the required amount of 'platform hours', which are the times during which an operator is in control of his vehicle. The efficiency of operations is based on assigning operators to provide the required platform hours at the least cost in terms of unproductive time. Accordingly, achieving good operator productivity is the central performance issue. All of the components of labour operations contribute to this.

6.1 LABOUR OPERATIONS

Labour operations involves the performance of operators in their daily operating activities. The time components of these activities follow.

Platform Hours including revenue hours, recovery and/or layover time at terminals, wait time at transfer points, deadheading to/from the routes. The planning function sets the overall platform hours, as discussed in Chapter 5, and thus this component is beyond the control of operations.

Paid Work Allowances for report time, pull-out and relief, clearing time for pull-in and relief and travel time. This time component is established primarily by the scheduling activity.

Paid Work Premiums for spread time, statutory holiday and Sunday work, late night work, overtime. This time component is established by the scheduling and dispatching activity.

Paid Non-Work Allowances for guarantee or make-up time, including cover time on spare-board, authorized absenteeism, coffee/lunch breaks, holiday and vacation time. This time component is established by the scheduling and dispatching activity.

Non-Paid Allowances for authorized and unauthorized non-paid absenteeism such as late in reporting for work, union business and non-certified illnesses.

The scheduling activity determines the allowances and premiums for the operators who have been assigned runs, and the dispatching activity determines this for the operators on unassigned runs. These unassigned runs result from trippers which cannot be scheduled into complete shifts, from the charters and extra runs which are unknown at the time of sign-up, and from the scheduled runs which become open because of service changes and absenteeism.

The paid allowances and premiums together with the platform hours determine the operators' pay hours and, therefore, are the major component of operating costs. The non-paid time allowances, when added to the pay hours, determines total operator hours. This in turn establishes the number of operators required to man the service.

Questioning Performance

The productivity of labour operations is based on the extent to which allowances and premiums can be kept to a minimum. When reviewing this activity, the following questions will assist in examining performance.

- How many Board periods are established in the collective agreement? What is the make-up of the regular and spare boards and the boards that are established for days-off and vacation relief? Are there enough Board periods to give management the flexibility to optimize labour allocation? Do the number of boards within each period limit this flexibility? Do the sign-up rules limit this flexibility?

- What rules are established for the sign-up of regular, spare and volunteer operators? (i.e., regular operators who volunteer to work at the end of their normal shift or on their day-off.) Are these rules in the collective agreement? Can management use volunteers who have time available without incurring overtime or must they distribute the work evenly among all volunteers?

- What are the allowances in the collective agreement? To what extent can travel time be reduced by restructuring the services or by changing the relief procedures? To what extent can pay guarantees be reduced by using more volunteers , or using part-time operators if appropriate?

- What are the premiums in the collective agreement? Is there a spread time limit? Can operators work three-piece runs within a given spread time limit? Is their scheduled overtime on the regular board and if so can this be reduced through restructuring? What is the relationship between the

overtime cost of volunteers and the covertime cost of spare operators on the spareboard? Would there be operating cost savings by increasing overtime and reducing covertime?

- What paid time-off is taken by the operators? Are vacation entitlements increasing because of aging operators (many properties are experiencing lower attrition rates than in the past and an increase in the years of service)? Are floating holidays designated in the collective agreement or are they scheduled by management (designated floating holidays increase the premium paid operators)? Are certification procedures for illness being adhered to?

- What is the non-paid time-off taken by the operators? Is there an absentee control program and if so how effective has it been in controlling absenteeism? What are the absentee trends? How long can an operator be absent without vacating his run? What is the cost of filling open runs on the spareboard?

Performance Indicators

As a first step in evaluating the performance of labour operations, the following overall productivity indicators might be used:

- platform hours/operator pay hours

- platform hours/total operator hours

While comparative historical data are not readily available for these indicators, the experience is that platform hours as a percent of total operator hours might be as low as 60 percent in some properties, and as high as 80 percent in others. The difference is due primarily to absentee levels and the sizing of the spareboard, both of which are under the control of operations management.

If the above overall productivity indicators show a poor performance, then other indicators can be used to highlight inefficiency in labour operations such as average annual days-off/operator, covertime on spareboard as a percent of total spareboard platform hours, volunteer platform hours and cost versus spareboard overtime hours and cost.

The review process will require this kind of background information before evaluating the other operating activities which are discussed in the following sections of this Chapter.

6.2 SCHEDULING

Operators pick their daily driving assignments from a crew guide or sign-up sheet. This is produced by the scheduling department at regular intervals or 'Board Periods' throughout the year. The crew scheduling activity, which is included here under operations, is usually handled in the larger properties by the

planning department because it supplies most of the data base for the preparation of the schedule. The efficiency of the schedule relies on the accuracy and timeliness of the information which is provided to the scheduling department from the sources which follow.

The Planning Function provides route descriptions in terms of terminal and timing points, running times, deadheading time, the desired headways and timing of the service on the routes, the required layover or recovery time - to provide complete cycles for the vehicles and policy headways, and the number and type of vehicles that are required for the revenue service on each route.

The Administrative Function provides personnel management information including the terms of the collective agreements, and any limitations which may affect the number of operators that are available to man the vehicles.

The Equipment and Plant Function provides information on the garaging of the vehicles, and any limitations which may affect the number and type of vehicles that are available to provide the service.

On the basis of this information, the scheduler writes the run schedule for each vehicle, cuts the runs into daily driving assignments, rosters the daily driving assignments into weekly crew assignments for the Board period (to account for days-off), and crews the weekly assignments by preparing the appropriate sheets for operator sign-up. After sign-up, the scheduler produces the following for the guidance of operating personnel:

- The Run Guide, which is supplied each operator, should be detailed enough to permit close schedule adherence.

- The Headway Sheets, which are supplied each inspector, should show enough time points to guide the inspector in supervising the service and controlling schedule adherence. The headway sheets are also supplied to the marketing function for purposes of preparing public timetables and should reflect normal operating conditions.

- The Crew Guides and Sign-Up Sheets, which are supplied to each dispatcher, are modified by the dispatcher to reflect the actual daily assignment and the modified sheets go to the payroll department where premiums and allowances are added for pay purposes. In this process, there should be feed-back from payroll to the dispatcher to reduce premiums and allowances, through efficient time-keeping systems.

- The Kilometre Reports and Pull-Out Lists, which are supplied to the equipment function, should be detailed enough to permit efficient vehicle assignment and preventative maintenance scheduling.

The vehicle schedule and crew assignment essentially represents transit management's plan for providing the required service, given the various constraints imposed by the structure of the service, the work rules of the collective agreement, the equipment limitations, and the policies of the policy group. The scheduler's responsibility is to produce economical and feasible

schedules that adhere to the transit organization's policies and practices while keeping within the terms and conditions of the collective agreement with the operators.

Questioning Performance

Because of the complexity of the scheduling decisions which must be made, there are a large number of factors which can influence the performance of this scheduling activity. The review should concentrate on those factors which have the greatest impact on system performance. The analysis of labour operations, as described in Section 6.1 above, will assist in isolating the important factors. Typical questions to assist in assessing performance follow:

- How does the route structure restrict scheduling efficiency in terms of multiple branches, short turns, deadheading, variable running times, daily and seasonal loading variations, peak to base vehicle requirements? To what extent is there close interaction between the planner and scheduler to work out the trade-offs between the runs that cannot be scheduled into eight hours shifts and restructuring the route to reduce the short pieces of work? Are there enough board periods to enable services to be tailored closer to the demand? To what extent can deadheading be reduced through such measures as a "closed-door" policy or having a satellite garage?

- How do the work rules of the operators affect scheduling relative to maximum spread times, two and three piece split runs, consecutive days off, minimum call-outs, daily and pay period guarantees, use of part-time labour? What has been the trend in these rules? How do they affect the pairing of trippers? Do they permit interlining and differential scheduling? To what extent are trade-offs explored in contract negotiations? What measures might be taken to have better informed bargaining on the part of union and management in contract negotiations?

- How do the policies of the policy group influence scheduling? Do they limit the availability of operators and vehicles? How does this affect crewing and overtime? Does the policy group have overtime restrictions and if so how does this affect dispatching? Does the policy group give management the budget to hire and train experienced schedulers and to what extent can management acquire appropriate support in terms of traffic checking and computerized scheduling systems?

- How proficient is the scheduling group? Is the scheduler experienced in handling large amounts of data simultaneously? To what extent does he adhere to the terms of the collective agreement while continuously exploring feasible ways to minimize the wage bill for the required service? To what extent does the group regularly attend courses to upgrade their scheduling skills? To what extent would computer systems aid in the scheduling process (such as RUCUS or the mini-scheduler)? Are these being considered or do budget limitations restrict their use?

Performance Indicators

To aid in evaluating the influence of the above factors on the performance of the scheduling activity, performance indicators need to be chosen that are not influenced by other transportation activities or other operating functions. While platform hours/pay hour is a good overall performance indicator, it is influenced by the scheduling, dispatching and route supervision activities. Therefore it is not indicative of crew scheduling performance alone.

For this review, scheduling indicators should be used which express the time occupied in various activities as a percentage of total operator hours. Suggested time components include:

- layover time (at terminals)
- deadheading time
- travel time
- spread time
- scheduled overtime
- guarantee time.

A further indicator is the number of straight shifts and split shifts as a percent of total shifts.

These scheduling indicators are influenced by the specific work rules in the collective agreement and the operating conditions that are unique to each system. Consequently, the review should use only historical data which is specific to the property, and not comparable historical data from other properties, when judging the performance of the scheduling activity.

6.3 DISPATCHING

Scheduled operators, starting from the garage, report to a dispatcher who assigns a designated vehicle from a vehicle disposition list supplied by the Equipment Department. When a scheduled operator fails to report, or when events dictate a need for additional operators, the dispatcher assigns an available operator from the spareboard or asks for volunteers to fill the open run. Dispatching is basically a time-keeping function which verifies that the runs pull-out as scheduled, that crews are assigned to open runs, and that changes to the crew schedule are reported to administration for pay purposes. As such, it is the main source of "actual" kilometre and hour information on the daily service.

Dispatching is a line operating function because it puts a given schedule into operation in response to events which could not be anticipated when preparing the schedule. The dispatcher's responsibility is to ensure that the response is adequate and appropriate at the time, that the operators on report (on the

spareboard) and volunteers are used efficiently with a minimum of overtime, and that the daily assignment of vehicles and operators are reported accurately to administration.

Questioning Performance

The following questions will assist when reviewing the dispatching activity.

- What are the restrictions imposed by the work rules of the operators on the filling of open runs by sparemen and volunteers? What advance notice is required? Can scheduled crews be switched, short turned or interlined to accommodate unanticipated delays and absence?

- What are the requirements for open trippers and unscheduled work on the spareboard? What are the requirements for open runs due to anticipated and unanticipated absenteeism? What are the cost trade-offs between hiring another operator to cover the spareboard versus paying overtime to an existing volunteer operator? What is the probability of paying guarantee time for covering on the spareboard? Is the spareboard at its optimal size, and if not, what needs to be done?

- What are the main components of unanticipated absenteeism (authorized and unauthorized)? How many operators are needed to fill the open runs resulting from unanticipated absenteeism? What components are under the control of management? To what extent are training and discipline a factor? To what extent is the quality of the working environment a factor? Are incentives given for good attendance?

- How efficient are dispatching practices and systems? Are the assigned vehicles parked in order of the time of pull-out and if not how does this affect performance? Does the dispatcher routinely miss runs and if so what are the reasons? How might dispatching be improved through better timekeeping and operator bidding systems?

Performance Indicators

When evaluating the performance of the dispatching function, indicators should be chosen such that the dispatcher's key responsibilities are highlighted as follows:

- average daily missed runs/total runs.
- average daily absent crews (open runs)/total crews.
- guarantee or cover hours/total operator hours
- unscheduled overtime hours/total operator hours.
- unanticipated absentee hours/total operator hours.

While unanticipated absenteeism and unscheduled overtime are not caused by the dispatcher, he can lessen their impact by making use of spare operators and volunteers to cover open runs. Accordingly, a useful indicator of these unproductive time components is unscheduled payroll cost/total payroll cost, including operator wages and associated premiums and fringe benefits.

6.4 SUPERVISION

When the operators have picked up their vehicles at the garage or relief point, they complete their first piece of work, are relieved by another operator or deadhead to the garage where they have a meal or rest break. After the break they travel to a relief point to pick up another bus, drive their second piece of work, and then usually deadhead to the garage where they sign-off. The driving or platform time from garage pull-out to sign-off is under the direct supervision of an inspector or line supervisor.

Supervision involves assisting the operators in maintaining schedule adherence, and in overcoming overload situations and traffic congestion. When problems occur, the inspector makes changes to the service by notifying the affected operators or by requesting additional operators and vehicles from the dispatcher if these cannot be corrected by the available services. The inspectors are normally in contact with the transit controllers or dispatchers by telephone or radio communications.

The supervision activity also handles driver training. If a part of management, the inspector may also assist in the discipline of operators, the administering of the collective agreement and, the arbitration of grievances. In most cases, the inspector prepares a daily report of his activities as an aid to the administration and future planning/scheduling of the services.

The inspectors are the first point of contact for the operators and, as such, have a major influence on their working environment. The inspector's responsibility is to ensure that schedules are maintained along the routes and that corrective actions are taken which are appropriate to the situation such as short turning vehicles, holding vehicles, inserting extra vehicles, taking vehicles out of service, and switching crews when appropriate.

Questioning Performance

The following are examples of questions that will assist in reviewing performance in supervision.

- To what extent do work rules and the crew schedule take precedence over changes which may be suggested by the supervisor? Can the supervisor change the schedule to maintain the headway, if necessary? Does the supervisor completely understand the collective agreement? Was he consulted during the negotiating process and if not why not? Is he a member of the union and if so, how objective is he in the administration of the agreement?

- To what extent do the operators have a good working environment with respect to ready access to the supervisors and clean and reliable vehicles? To what extent does this affect their attitude and driving performance? To what extent are service delays caused by unreliable vehicles?

- Where do complex route structures with multiple branches and blending make the inspector's schedule maintenance activities difficult? To what extent are the inspectors consulted by the planners and schedulers to work-out trade-offs between service planning and crew scheduling?

- To what extent do erratic loading and running times due to traffic conditions disrupt the service? To what extent are they accounted for in the schedule and to what extent do they go undetected? To what extent do vehicles bunch as a result of traffic conditions and running times which are beyond the control of the operators?

- To what extent are training programs available to develop line supervisors? To what extent are the supervisors kept informed of the policies of the policy group and management? Are the supervisors readily accessible to the operators? How are the supervisor's reports acted upon by the administration? To what extent would communications and information systems improve this accessibility and reporting? Would there be closer schedule adherence and reduced passenger waiting times and uncertainty?

Performance Indicators

When evaluating the performance of the operator supervision activity, indicators should be chosen such that the supervisor's key responsibilities are highlighted as follows:

- average on-time performance at key points; percent of runs zero to three minutes late.

- average actual versus scheduled headway at key points.

Operator performance is a key responsibility of the supervisor although poor operator performance does not always reflect on the supervisor. It also is a reflection of a variety of elements such as weather, working environment, communications, labour relations, training, discipline and personnel policies. Nevertheless, because of the supervisor's role in many of these elements, it is useful to know the frequency of the incidents which are caused by the operators. In this regard, possible indicators might be:

- complaints about operators/total complaints from public

- number of operators with more than three operator-related incidents of the same type over a designated period.

6.5 TRANSIT CONTROL

From time to time, an operator experiences an emergency incident while driving the route which will require assistance in the control and clearance. The control and clearance of these incidents is the primary responsibility of transit control. Transit control involves a transit controller taking calls from operating personnel in the field, verifying the nature and extent of the request, and routing the calls to the appropriate people for action. Vehicles requiring on the road repairs or replacement, passengers and operators in distress, traffic accidents, crimes, and fare disputes requiring management intervention are normally handled by this activity.

The controllers are the second point of contact for the operators, after their line supervisors and are the final arbitrator in decisions which affect the operation of the services on the street. The controller's responsibility is to ensure that the response time to an emergency incident is kept to a minimum. He ensures that the service is restored quickly through such measures as notifying police, fire or ambulance services, dispatching road crews and supervisors to the scene, and coordinating the various agencies and crews.

Questioning Performance

The following questions will assist when reviewing the transit control activity.

- How many emergency problems are created by long routes into underdeveloped areas, routes through high crime areas, late night service? Are the controllers consulted by management and its planners on ways to improve the situation?

- Where do traffic and road conditions create erratic loading and operating conditions which cause higher than normal emergency incidents? To what extent does poor road conditions affect vehicle breakdowns? Where are accident and danger spots? What action is taken to notify other City Departments of these problems?

- How do the operators contact the controllers? Can this be improved? What impact does operator attitude have on the emergency incidents? Is a small group of operators involved in the majority of incidents?

- To what extent are the present practices capable of quickly restoring service without delaying the passengers? Can extra vehicles be quickly inserted when there has been a breakdown? Are the present communications systems outdated and if so how might they be improved? How are radio systems being used or misused? Would response and restoration times be improved with more sophisticated transit information, communications and control systems?

Performance Indicators

When evaluating the performance of the transit control activity, indicators should be chosen such that the controller's key responsibilities are highlighted as follows:

- average response time; time from when call was received to when corrective action was taken on the scene.
- average restoration time; time from when the corrective action was initiated to when the service was restored.
- transit related incidents not caused by operators/hundred thousand vehicle kilometres
- non-transit-related incidents/hundred thousand vehicle kilometres

6.6 INFORMATION SOURCES AND ANALYSIS

To review the overall performance of the transportation operations function, the following data sources and analyses are suggested:

1. Assembly of data for the last board period including:
   - present collective operator agreement
   - the service plan and requirements from the planning group
   - the crew guide from the scheduling group
   - payroll records from accounting
   - absentee records from personnel
   - dispatch logs
   - incident reports on operators from personnel
   - other incident reports from the appropriate function
   - inspector's reports
   - controller's logs
   - complaints summaries
   - operating statements for transportation function (staff strength, available vehicles, total operator hours)

- financial statements for transportation function (wages, benefits, premiums)

- interviews with transportation management including schedulers, dispatchers, supervisors, and controllers

2. Assembly of comparative statistics (that is, statistics which have already been collected and could likely be made available by comparable properties).

   - collective operator agreements

   - past 5 year hourly related information (revenue hours, platform hours, pay hours, overtime hours if available)

   - CUTA statistics on man-days lost by property

3. Calculation of the basic overall indicator of operating efficiency for the past 5 years (platform hours/total pay hours); determination of this indicator for other comparable properties.

4. Based on interviews and on an analysis of the collective agreements, estimations of future 5 year "trends" in this basic indicator; establish "desired" targets.

5. Calculation of the unproductive components of operator's time (refer to Section 6.1).

6. Based on the findings of Step 5, identification of the key activities which need further study, and calculation of the appropriate performance indicators for these activities to aid in this study.

Data assembly for the transportation operation activity is a time-consuming exercise, but a worthwhile one. Thus, the above steps have been chosen to reduce workloads by quickly concentrating on the elements which will have the greatest influence on operating efficiency.

6.7 SUMMARY

The review of transportation operations involves the assessment of performance shortfalls as determined from the questions and the performance indicators in the key activities, as suggested in this chapter. It is recognized that only some of these indicators may be available, but these will help in Phase One of the review process.

The principal areas for review to decide if and where performance can be improved follow.

Union Negotiating Strategies, as a means to lessen the impact of restrictions on maximum spread time, split runs, consecutive days-off, call-out for short pieces of work, use of volunteers, use of part-time labour.

Labour Management Practices, as a means to improve operator's working environment and unproductive time such as unanticipated absenteeism, covertime on spareboard, and unscheduled overtime; including systems for optimizing spareboard sizing and unscheduled payroll costs, and for controlling unanticipated absentee levels.

Scheduling Practices, as a means to reduce platform hours using techniques such as interlining and differential scheduling to improve the pairing of trippers; including training methods and computer systems to upgrade scheduling skills.

Supervision and Control Practices, as a means to improve the response to events and the restoration of service when delays occur; including systems for communications, monitoring and control.

At the conclusion of this assessment, the review should produce a report which focuses on where operations management can improve performance of staff or reduce the number of vehicles in service through changes in procedures, the collective agreement or the established policies of the policy group and senior management.

7 EQUIPMENT AND PLANT MAINTENANCE

This chapter deals with those activities that affect performance in the Equipment Department. The function of the Equipment Department is to provide the Transportation Department with an agreed number of clean, safe, well serviced and maintained buses or other rolling stock, where and when needed, at minimum cost.

The major sub-activities undertaken in the Equipment and Plant Department may be classified as follows:

- Organization, Management and Supervision
- Maintenance
- Daily Servicing
- Miscellaneous Garage Operations
- Stores
- Buildings and Plant

Performance in the shop depends on how well the management and staff, individually or collectively, carry out these sub-activities to achieve maximum productivity per man, per shift and per dollar spent in the garage.

Maintenance management for maximum productivity is a three pronged thrust with the Maintenance Chief playing the major role. In addition to setting up the departmental organization and objectives, he must work closely with the General Manager to ensure that management has provided the support and basic elements needed to enjoy productivity and vehicle reliability. There must also be foreman involvement to ensure that the shop methods and procedures have incorporated in them, the hands-on practical experience needed for maximum effectiveness.

7.1 ORGANIZATION, MANAGEMENT AND SUPERVISION

The three levels of management, that is, the General Manager, the Maintenance Chief and the Foremen all influence productivity in the shop. The specific areas in which each of them does this, follows.

The General Manager

Leadership - The General Manager must show evidence of a strong commitment by top management to improve productivity in the shop. This means ensuring that the support and cooperation of other departments, Transportation, Personnel and Labour Relations, Finance and Purchasing are readily available. In addition he must provide the leadership that makes for a positive atmosphere that includes encouragement, support, guidance and good communications so that all personnel clearly understand and are in a position to attain departmental objectives for productivity. He must work for a labour contract that is fair, does not impede working rules, job assignment and other shop methods designed to achieve good productivity.

Support - Proper facilities, with good functional layout, equipment, tools and instruments, as recommended by the Maintenance Chief are also a basic requirement. Your bus replacement policy should conform to the MTC recommendation of keeping the average age of fleet at one-half of the expected useful life of the equipment. Furthermore, the award of tenders for new buses should be based on an evaluation which takes into account initial cost, operating cost and maintenance cost, not just low bid. Finally, the General Manager should ensure that the disposition of buses between the Transportation and Equipment Departments is fair and reasonable so that there are no misunderstandings and each can plan in advance for an efficient operation with full assurance of complete cooperation.

The Maintenance Chief

Administration - The Maintenance Chief should ensure that the General Manager is well informed on major shop requirements which involve large capital outlays. This information should be on record so that it may be presented to the policy board if required. His departmental operations must be well organized. There should be a shop organization chart showing who reports to whom and who is responsible for what. It should be posted on the shop bulletin board together with shop rules, technical and service notes, union matters and employee information. A comprehensive preventive maintenance program establishing procedures and schedules for all scheduled maintenance should be in place. Diagnosis procedures for unscheduled maintenance should also be established to eliminate 'trial and error'. There should be 'targets' for component life in kilometres together with rebuild procedures and schedules to monitor performance so that maximum component life is enjoyed with a minimum of costly breakdowns. Work improvement techniques and work simplification programs should be implemented to eliminate waste motion, waiting time and repeat work. (This is explained further under maintenace.) He must arrange for the provision of records and data to reflect performance, and systematically review these on a regular basis to arrive at conclusions and decisions that will enhance performance.

Training - All shop Foremen and supervisory staff should be given training on how to manage, how to plan work, the importance of records and the written word for issuing work (use of a job-ticket system). All should be kept up to date on new methods and procedures. The Maintenace Chief will normally provide the logic, organization and technical guidance, but when it comes to converting these principles to shop procedures and methods to improve productivity they should receive input from the Foremen to ensure that they are practical at the working level. Items in this category are, the use of instruments, power tools, automatic equipment, jigs and fixtures, diagnostic techniques (trouble shooting), and control boards. The same applies to mechanic training, working conditions and employee morale.

Communications - Communications with other Department Heads, Supervisors, drivers, garage staff and the union is very important. The better the communications, in both directions, the more interest and enthusiasm there will be. The Maintenance Chief should think in terms of a team and of the others on

the team. Also he should remember that his staff is entitled to work satisfaction, recognition and opportunity for advancement and that good productivity and morale generally go hand in hand.

Contracting - The Maintenance Chief should review periodically the possibilities of contracting out work which ties up the shop unduly, for example a bus rebuild from a major accident and conversely, accepting outside work contracts from other transit properties, such as engine rebuild, to keep the mechanics gainfully employed. Also consideration should be given to the advantages of lease versus purchase for tires, batteries, service vehicles and other such items.

The Supervisory Staff

The supervisory staff (Superintendent, Foreman, etc.), in the shop is management's front line at the working level. Its major responsibility is quality - good workmanship and productivity - keeping the staff gainfully employed at all times. The Foreman who can deliver these is one who is basically intelligent and sincere, was a good mechanic and motivates easily. He should enjoy good communications with management relative to operations in general, to specific objectives, to planning and capital forecasts. He is the one who must explain these to the garage staff, and see that they are understood and carried out properly.

Work Planning - The Foreman should plan his work in advance to keep his staff gainfully employed at all times. He should have a job ready for all of his men at the start of every shift. The job should be described on a job-ticket along with the bus number and other significant data. Further, the bus should already be placed in the repair bay by a garage attendant and all the tools and a kit of parts ready and available at the stores counter. The Foreman should follow up on jobs assigned. That is, when the mechanic is about half-way through the job, he should drop by and enquire - "How are you making out? - Any difficulties?" If assistance or guidance is needed, it should be given immediately Before moving on, he should check to ensure that the mechanic is following the proper procedure and not taking short-cuts which would result in poor workmanship or repeat work. Obviously to do this properly he must be thoroughly familiar with all the maintenance procedures.

Good Work Controls - The planning of scheduled work to be assigned to the staff should be logged on a daily control or work sheet so that the Foreman has a record of what job every man is on and when he should be finished. He should always have in advance for the mechanic a new job-ticket for his next job and ensure that the mechanic gets into it with no delays as this can be a serious source of lost time. At the end of the day the daily work sheet, which was prepared in advance for planning purposes, becomes a record of the day's work. This routine should apply to all scheduled work done in the shop and should occupy about 75 percent of the staff. The remainder should be available for unscheduled work such as road calls, trouble shooting and other such jobs which come up at the last minute.

Diagnostic Procedures - The Foreman has to ensure that unscheduled maintenance is properly diagnosed. Unscheduled maintenance is breakdowns,

malfunctions and failures that occur between scheduled maintenance calls. The most common examples are poor or grabbing brakes, hot engine, no power, dead battery and, in the winter, no heat and improper door operation. To correct these faults there should be a diagnosis made to establish the cause and then to correct it. If not, the same trouble will occur again and create repeat work. To check and control this possible loss in productivity, the Foremen and Maintenance Chief should collaborate on the development of diagnostic procedures using past records, instruments, etc., which check out in order of occurence, the usual causes of failure. These should be written up as diagnostic sheets, leaving space for the mechanic to record entries such as 'yes' or 'no' or an instrument reading. Then, mechanics should be trained on the understanding and proper use of the diagnostic sheets. It is vitally important that trial and error not be permitted as, too often, this leads to repeat work. Repeat work represents wasted effort and wasted dollars.

Supervision - Good communications by the Foreman can contribute to good union relations. The Foremen are in the position to sense union and employee attitudes as well as the beginning stages of negative situations. These should be drawn to the attention of the Maintenance Chief immediately so that some action, usually a meeting with the union can be taken to clarify or rectify the situation. Foremen, however, must not accept laxity or delays in personnel getting at a job as soon as a job-ticket is issued or when coffee break is over. Also personnel collecting around the stores issue counter, particularly at start and end of the shift should not be tolerated. But to enjoy good shop morale and to motivate personnel, the Foreman's best approach is "honesty and sincerity".

Records - The Foreman should receive proper records and reports on oil consumption, maintenance costs, component life, road calls and the like for control and monitoring. It is important that these be forthcoming on a regular basis. Similarly, schedules of buses due for inspections and other scheduled work programs must be obtained on time.

The Smaller Shop - In smaller shops, the Foreman is often in charge of stores, initiates purchase orders and prepares most of his own records and paper work. This can be time consuming and cause productivity to suffer. Management must consider when to provide a clerk to do the paper work so the Foreman can get out on the floor to supervise his men and plan his work.

Performance Indicators

The indicators by which the maintenance management team performance may be measured are:

- Bus maintenance cost in cents per kilometre.
- Total cost of garage operations, that is, maintenance, servicing and miscellaneous garage operations in cents per kilometre.
- Man hours per 1000 kilometres for bus maintenance, servicing, miscellaneous garage operations and total garage operations.
- Kilometres per road call.
- Number of grievances per month.

- The general appearance and cleanliness of the bus fleet based on opinions of passengers, drivers, the public and the media.
- Repeat work.
- Spare bus allotment kept for maintenance and the number of times the agreed to number was exceeded.
- Number of buses unserviceable for more than one week.

Performance in the garage may be more readily appraised if it is divided into the separate major accounts that contribute to the overall performance as follows:

1. Maintenance: This covers all labour and material used in repairs, inspection, rebuild, etc., including outside work but not including accidents. The maintenance labour is usually that of mechanics only (but mechanics do not necessarily do maintenance work only). The cost of accidents (as for tires) should be shown separately as it is not a measure of how well the bus was designed and manufactured or the cost of maintaining it.

2. Servicing: This covers all the labour and material used in the daily servicing operations to prepare the vehicle for use the following day.

3. Miscellaneous Garage Operations: This covers all labour and material used by garage staff on work which is not maintenance or servicing, such as steam cleaning, interior wash, making bus changes, moving buses, starting and placing buses, etc.

4. Buildings and Plant: This covers labour and material for building and plant maintenance, painting, inspecting and repair of garage equipment, janitorial services, etc., shelters, bus stop poles and signs, grounds, etc., and other, not related directly to bus work.

5. Fringes and Benefits: The labour charged to the above accounts should be direct labour only. All fringes and benefits which consume labour such as coffee breaks, wash up time, holidays and vacation, etc., should be charged to a separate account. This will help all concerned to appreciate that based on the 2080 hour year (40 hour week x 52 weeks) the average hourly paid garage worker actually puts in less than seven working hours per day.

The cost of labour for storesmen and clerks should be kept in another appropriate account. The same applies to supervisory personnel.

By keeping these items in separate accounts it is relatively simple to convert them into cost per kilometre. By taking labour only and dividing by the weighted hourly rate, man hours may be determined to provide man hours per 1000 kilometres of service. The advantage of using man hours is that the escalation in the cost of labour is no longer a factor so that comparisons to other years (or properties) may be made quite easily. On larger properties an even more detailed breakdown should be considered to indicate the cost of the maintenance operations and major bus components and parts. It can also indicate the relative merit of the type of bus used. An example of this is shown in Exhibit 7-1.

TYPICAL BREAKDOWN OF BUS MAINTENACE COST
FOR MEDIUM SIZED URBAN TRANSIT BUS FLEET (1982 DOLLARS)

Account	Labour Man-hrs/1,000 km	Material Dollars/1,000 km
1. Brakes, reline	0.50	14.80
2. Brakes, running repairs	0.35	0.30
3. Engine	0.45	6.40
4. Engine oil & filter change	0.15	1.05
5. Fuel system	0.20	2.60
6. Front axle & steering	0.15	3.40
7. Rear axle & diff.	0.15	2.60
8. Suspension system	0.30	7.20
9. Transmission	0.40	13.50
10. Air system	0.15	3.40
11. Cooling & body heat	0.35	3.40
12. Electrics & batteries	0.45	10.60
13. Body, paint, doors & w/w	0.65	10.20
14. Upholstery	0.15	0.45
15. Inspections	0.60	-
16. Tires	0.25	11.40
TOTAL MAINTENANCE	5.25	91.30

Average hourly rate = $12.00

The above figures represent a reasonably well managed bus maintenance operation of around 150 buses. The breakdown of costs is typical for a fleet of 12.3 m urban transit buses with average age, 8 years.

These data may be converted to cents per kilometre as follows:

labour cost - 5.25 x $12.00 = $ 63.00

material cost = 91.30

Total cost = $154.30 per 1,000 kms.

$$\text{maintenance cost} = \frac{\$154.30}{1{,}000} = 15.43 \text{ cents/km.}$$

Note: The above includes only direct labour and material cost used to maintain, inspect and repair buses and bus components. Any work contracted out should be included as material cost. It does not include servicing, miscellaneous garage operations, accidents and fringe benefits.

EXHIBIT 7.1

Labour productivity in man hours per 1000 kilometres and maintenance cost in cents per kilometre can then be plotted to indicate trends and performance. An example of this is shown in Exhibit 7-2. The costs are expressed in current dollars and converted to constant dollars.

For smaller transit systems with a more limited records capability maintenance cost may be reduced to only the following major categories: inspection and lubrication, engine, transmission, brakes, battery and electrical, body, other mechanical, and tires.

The source for all the above data and information is readily available from shop records and time sheets and from payroll and budget control records. In some cases these are produced on a monthly basis but if not they can be found in the annual summary of costs.

Questioning Performance

Management at all three levels should be questioning performance. The questions should be probing for areas of improvement, technically, financially and in employee and union relations. Typical questions would be:

For the General Manager

- Why is the spare bus allotment as high as it is? Could it be lower? What are the trade-offs?
- Is the Transportation Department receiving its proper peak hour bus allotments as planned? Is the Transportation Department completely happy with the Equipment Department performance? Do they have any strong differences which seem to go on and on?
- How does our maintenance cost per kilometre compare to other properties similar to ours? Are they any lower and if so, why?
- How does the general appearance, cleanliness and performance of our bus fleet rate, based on the opinion of passengers, drivers, the public and the media?

For the Maintenance Chief

- Are our facilities, equipment, buses, methods, etc., becoming obsolete? Are we keeping up with technology? Are we using the newest techniques, instruments, electronics, etc., to measure, monitor and control?
- Have we done any cost/benefit analyses this year for new equipment, tools, instruments? Did any of these result in a request for purchase? Were we refused and if so for what reason?

TRENDS IN
LABOUR PRODUCTIVITY AND MAINTENANCE COST

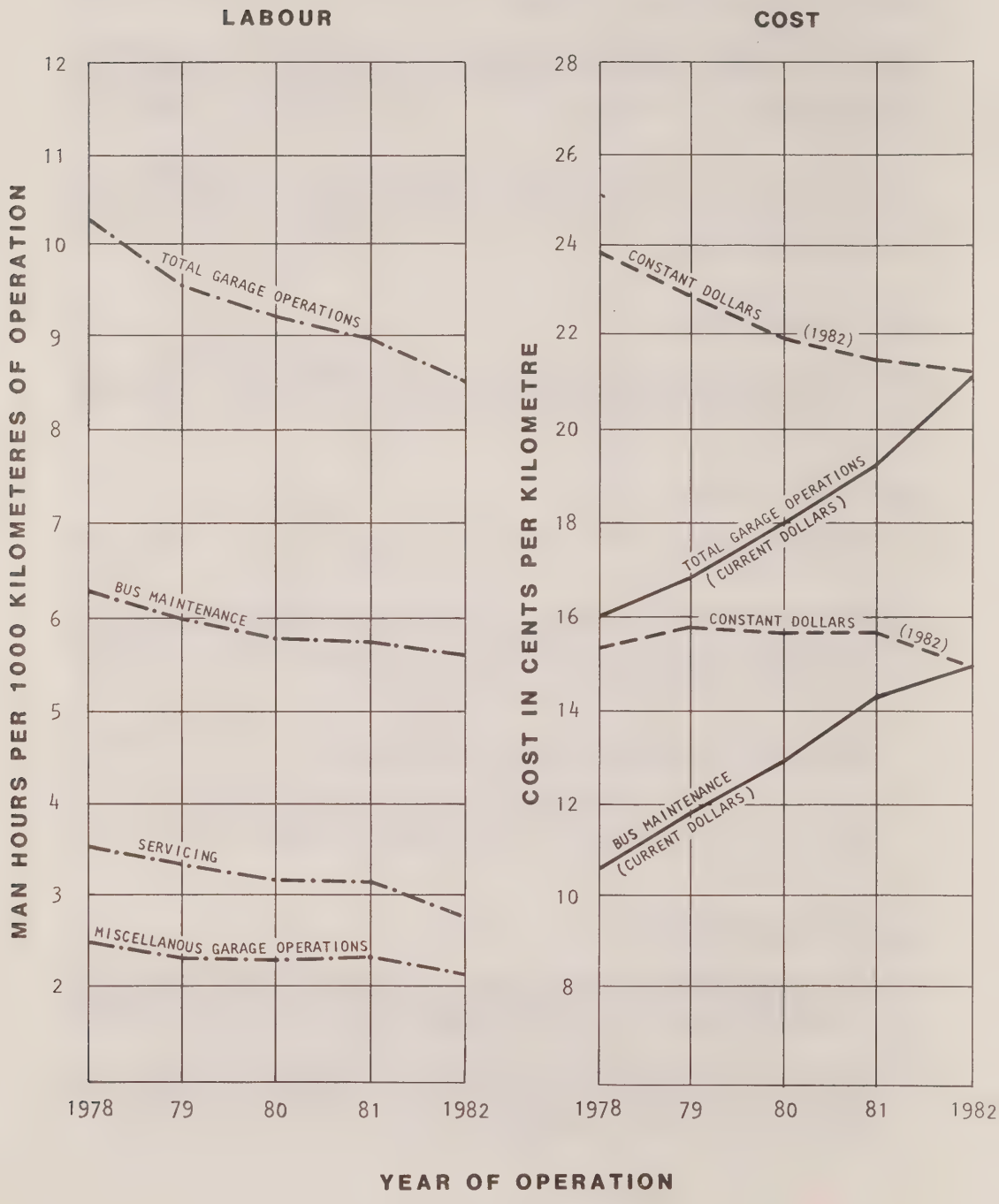

EXHIBIT 7.2

- What should be done to improve our relations with the union? Listen more? Communicate? Invite them to join us in some of our planning? Do some of the foremen need counselling on how to manage men, how to be more effective supervisors?

- Have we probed all the opportunities and principles for eliminating waste motion and put them into practice?

- Are the performance indicators showing improved productivity? How do they compare with previous years? Are there any significant trends indicated from year to year?

- What can the General Manager do to help me and vice versa?

- What are other properties doing that we may learn from?

For the Foremen

- Where are the bottlenecks in my operations? Are they from shop layout, lack of automatic or power operated equipment, tools and instruments, poor documentation or records, lack of parts, inadequate staff and/or training?

- What are the major areas of equipment failure and repeat work? Do I have a good system for gathering this data and analyzing it? Has it been effective in the past for overcoming problems? Maybe it's time I reviewed them with the Maintenance Chief - maybe there is some way of promoting more input, ideas, suggestions, etc., from the mechanics?

- How do I rate as a Foreman? Am I the 'nice guy' type - easy going and pleasant, go along with the men, cover up for them now and then - and in return do the men take advantage of me? Or am I too aloof, strict and rather uncommunicative - to keep the men in line. Is my major concern - "Do they like me?" or "Are they doing a good job?"

- Do I communicate well enough with my staff, my supervisors, the drivers etc.? Does the staff understand and appreciate our objectives, our working conditions, etc. Maybe I should get them together for half an hour now and then, say between 4:00 and 4:30 on Friday afternoon when everyone is tapering off, and talk shop with them, tell them more about our objectives, our problems and answer some of their questions - sort of an informal 'bull-session'. Perhaps the Equipment Manager or the General Manager would like to join in on the odd session? Perhaps this would short-cut complaints and grievances?

- Since we have been reaching for improved productivity which often amounts to a mechanic doing a job in less time because of better procedures, - has our workmanship and reliability suffered? Are mechanics and servicemen taking short cuts to meet the new time standards? Are our inspections and servicing as good as ever? What has been the impact, if any, on road calls?

7.2 MAINTENANCE

Maintenance covers the inspection, repair and rebuilding of major components, transit buses and service vehicles. Lubrication periods and oil changes are usually coordinated with inspections. The maintenance activities fall into two major categories, scheduled maintenance and unscheduled maintenance.

Scheduled Maintenance - includes all types of work and repairs that are planned to keep wear and tear under control so that breakdowns are an absolute minimum. A comprehensive plan, normally termed a "preventive maintenance program", should be put together so that there can be a definite number of vehicles assigned for maintenance with maximum assurance that the Transportation Department will have all the vehicles it needs, at the right place and at the right time to meet its service schedules. The items which fall into this category are inspections, component changes, brake relines, injector changes, in fact any maintenance operation that is repeated at about the same kilometrage interval.

Unscheduled Maintenance - includes the remainder of the work load such as, road calls, running repairs and breakdowns, that is, anything that is unforeseen and must be attended to almost immediately. It should be obvious that if the preventive maintenance program is mediocre, breakdown maintenance will increase. This can be dangerous because breakdown maintenance is more costly, less productive and can frustrate the whole maintenance effort. In other words, reliability and good workmanship will improve productivity not only by reducing repeat work and breakdowns but through reducing confusion, delays and chasing work which cause the planned preventive maintenance to fall behind.

Given good facilities and equipment, a proper choice of bus, technical and managerial competence on the part of the Maintenance Manager and the Foreman, the following factors can enhance maintenance productivity.

Disposition of Vehicles - As mentioned above a schedule for the 'Disposition of Vehicles' should be prepared jointly with the Transportation Department as far as possible in advance, keeping an eye on the experience of previous years and new trends, if any. It should also provide for a dead bus allowance for accidents, which should be included in the Transportation Department allowance. A typical summary of these would be; 10 to 12 percent, 8 to 10 percent and 6 to 8 percent of the active fleet for maintenance for small, medium and large properties respectively, with the remainder going to the Transportation Department for service, spares and accidents.

Work Improvement Techniques - For all repetetive maintenance activities, work improvement techniques and work simplification programs should be implemented to eliminate waste motion, waiting time and repeat work. These should include the following steps.

First review and analyze the job history and records for trends and peculiarities. Then break the job down into elements and draft a procedure that satisfies the technical requirements of the vehicle maintenance manual, incorporates the preferred tools, jigs and fixtures, and is done in the most logical order. Then

train a few average mechanics on this "standard procedure", and establish a "standard time".

"Standard times" for "standard procedures" may be developed for 75% of all the work normally done in a transit garage. They can provide the opportunity to reduce the labour content in most jobs by ten to twenty percent. The employee does not have to work any harder - he simply works "smarter". Ideal applications are jobs of a repetitive nature such as daily servicing operations, inspections, component changes, component rebuild, brake relines, interior bus wash or cleaning, steam cleaning, bus exterior paint job, etc. Standard procedures also ensure that all jobs will be done the same way, the best way. Standard times provide the Foreman with information so that he can plan most of his work in advance with the assurance that it will be completed by the end of his shift and his staff will be gainfully employed at all times.

Management Support - When a Work Improvement or Simplification program is implemented to improve productivity, staff often feel they are working harder because they are given less time. The time reduction is actually a measure of the waste motion that has been eliminated and better tools, etc., that have been provided. Nevertheless there are usually complaints and grievances from the Union in this regard. The General Manager and Director of Labour Relations should be prepared to back up the Equipment Manager and Foreman otherwise productivity gains will be stifled. Management should make it a point to remind the staff and Union that the program has upgraded working conditions which has made their working conditions and procedures easier and better.

Scheduling Work - When setting up the above procedures, the principles and techniques used in work improvement and simplification programs should also be applied where ever possible. For example, to do work required from inspections, move the bus from the inspection bay to an adjacent work bay and do it while it is in the garage, use the inspection sheet of "work required" or "trouble found" as the job-ticket for the mechanic who will be doing the repairs. If possible hold off on minor repairs and schedule them for the same day the bus is being called for inspection; likewise for oil changes, lubrication schedules and unit changes. Mechanics should not work in pairs. If some assistance is required to lift or hold, etc., some predetermined arrangement should be followed.

Component Life - Component life should not be 'fixed' at a predetermined figure. It should be monitored through the use of instruments and the component should not be removed until instrument readings indicate wear or performance has reached unacceptable limits. This ensures long life consistent with a minimum chance of breakdown. The target 'life' may be increased as performance improves and better techniques become available.

Spare Units - To assist in keeping the men gainfully employed and, to reduce vehicle down time, it is helpful if there are on hand an adequate number of spare units. For example, a complete power plant assembly (engine, transmission and components) can reduce bus down time for an engine rebuild from three weeks to two days. And the rebuilding of the various units and components can provide work during peak hours or other times when there is a shortage of vehicles which need work in the garage.

The Use of Instruments - As mentioned in the foregoing the use of instruments should be applied as much as possible. Instruments or any device (even a ruler) that can indicate a positive/objective measure of component condition or performance offers an advantage to improve productivity.

Inspection Program - Inspection calls should be controlled by the Maintenance Department for total control. A very easy and satisfactory system for doing this is relating miles operated to weeks of operation. For example, a Safety Inspection primarily to adjust brakes, called every two weeks equates to about 2 400 km of operation. Then 'A', 'B' and 'C' inspections would simply be a multiple of the above and a calendar can be marked to show inspection calls for up to six months in advance if desired. Inspections should not be permitted to fall behind. Buses for inspection today should have been booked to have the engine compartment steam or spray cleaned a day or so in advance.

Inspection Procedures - All inspection procedures should be organized to eliminate waste motion. After the inspectors are trained on the procedure, a standard time for each type of inspection should be established. This will permit scheduling a given number of inspections per day with almost total assurance that they won't be left unfinished at the end of the shift. Inspections are best done on the day shift when more favourable working conditions prevail.

For all inspections there should be an inspection card or sheet with boxes for all the significant data to be recorded and a check list of all the items to be inspected. Also there should be a companion procedure written up for each inspection outlining in detail specifically what should be done, why, how and what tools, instruments, etc. should be used. It should be as objective as possible. If subjective terms such as check, test, inspect, etc., are used on the inspection sheet, maximum and minimum tolerances and conditions should be provided. For example, check oil pressure on the inspection sheet should be explained in the companion procedure of the inspection as - "record oil pressure at 1500 rpm after engine is warmed up". All personnel who do inspections should be given a copy of the procedures and training to make certain they are understood and followed.

The procedure should indicate the order in which the various operations should be done. For example, start at the front and progress systematically towards the back - or, in the engine compartment, from the left to the right, etc., (similar to a pilot doing a cockpit check). This helps assure that waste motion is minimized and nothing will be missed. There should be no waiting and watching, for example for the motor oil to be drained - for the air tank to drain, etc. The valve should be opened as required and while draining is proceeding the inspector should be completing other operations. Likewise there should be no fixing and cleaning during the inspection. For example, instead of cleaning air filters (heating system) on say 'A' inspections, have some spares on hand which were cleaned when more convenient, and simply replace the used filter with a clean one.

Inspection Staff - Inspections are one application where the job can be done efficiently by two men. They should work as a team and the work load (time) of each should be equal. The senior inspector (say Class I) should be a well qualified

mechanic. The other (say, 2nd class inspector) may be less skilled and should do items such as checking windshield wiper operation, tire pressures, interior body and seats, etc. Likewise the 2nd class inspector should do all the moving and fetching of buses to be inspected while the 1st class inspector does the recording and gets set up for the next bus to be inspected.

Inspection Follow-up - The repair of defects found on inspection should be corrected as soon as possible after the inspection, by another mechanic while the bus is still in the shop. When buses are in for inspection, components which have reached the end of their "useful life" should be changed. This eliminates bringing the bus back into the shop another time.

Performance Indicators

The measure of productivity enjoyed in maintenance and inspection would reflect the amount of support provided by top management, the extent to which the principles of work simplification and improvement have been applied by the Maintenance Chief, the planning, supervision and guidance by the Foreman and the training and motivation received by the workers.

The most important indicators for performance monitoring would be:

- man hours/1000 kms and material cost/1000 kms for maintenance
- maintenance cost in cents per kilometre
- kilometres per road call
- relative life (kilometres) between component change or rebuild.

Questioning Performance

The Maintenance Chief and Foremen should be constantly questioning the maintenance performance. An analysis of road calls, repeat work and work found necessary from inspections will suggest where to look. The questions should relate to the following:

- Was the failure due to workmanship, improper procedure or poor materials?

- Is the failure unusual? Is it likely to occur on other buses of the same type and vintage?

- Do we have any types of failure for which we don't have an answer? Has it been discussed at OUTA or CUTA maintenance workshops? Did anyone seem to be familiar with the problem?

- How do our maintenance methods, shop equipment, tools and instruments compare with others? Are we using instruments and electronics to their full potential?

7.3 DAILY SERVICING

Servicing is the term used for all the services and operations designed to have the bus properly prepared to go out again for revenue service the next day or for its next run. Servicing is not a repair activity. It has little or nothing to do with repairs and the servicing routine is usually the same no matter how old the bus is or how many hours it was in service.

Likewise servicing should not be considered an inspection even though a check is made for obvious leaks, broken fan belts, mirrors, lights, tires, etc. Daily servicing consumes a relatively large amount of labour, in fact about the same man hours as is usually required for inspections, engine, transmission and brake maintenance all put together.

It is generally not desirable to involve mechanics and drivers in the servicing operation. Servicemen are generally considered a semi-skilled category of worker but are none the less intelligent and if given sufficient training and guidance can contribute a great deal to good productivity and reliability in the servicing operations.

A normal servicing operation usually contains the following elements:

- Fuel refill.
- Check motor oil and "top" as required.
- Check motor coolant, "top" as required.
- Check transmission oil, "top" as required (once weekly).
- "Bump" tires (front and back).
- Check brake pedal "feel" and air pressure drop for brake application.
- Check interior lights, headlights (high and low beam), all clearance lights, brake and reflector, sound horn.
- Check mirrors.
- Check windshield wipers and windshield wiper operation.
- Clean inside (sweep, vacuum or 'cyclone').
- Clean dash, operator's seat, steering wheel (damp cloth) and windshield.
- Check door operation (front and back).
- Make "walk-around" check for dents and scratches to body and bumpers.
- Wash exterior (pass through bus washer).
- Dump farebox (Manager's discretion).

The key factors influencing efficiency and productivity are as follows:

Facilities - Servicing operations are best done indoors. Suitable facilities and equipment are essential particularly a high speed fuel pump and a power operated bus washer.

Procedures - There should be written procedures for the servicing operations. They should eliminate non-productive time, that is, waiting and walking, outline every detail of the servicing cycle and stress the important operations which can prevent "road calls". All the work elements in the cycle should be divided equally among the servicemen who should have some operation to perform, every

step along the way. For example, while the fuel is being pumped using an automatic shutoff nozzle, the serviceman should be doing some other elements of the cycle that will keep him occupied until the pump shuts off automatically. At the same time another serviceman can be sweeping or vacuuming the interior and yet another dumping the farebox. Each serviceman should have a copy of the procedures for all operations and be trained to do them efficiently.

As soon as there are enough buses on hand in the garage to gainfully employ a serviceman full time, servicing operations may begin. It is generally desirable to employ at least two men on this work in event that one takes sick or does not report for work, particularly at night. Productivity losses stem from things such as, allowing the same servicing time and cycle for tripper buses as for buses that have been in service all day - and having the serviceman start his own bus and sit in it for thirty seconds or so waiting for the air pressure to build up. This can be eliminated by having the bus started by the serviceman ahead so that when the next serviceman arrives to get a bus, the engine has been idling at normal speed for a few minutes and the air pressure is up. Obviously, before he boards this bus he should start the next bus so it is ready, with air pressure up, for the serviceman who follows.

Parking and Traffic Patterns - The placement of the buses by the drivers in the storage garage should be such that, when the serviceman has completed the servicing operations on a bus and parks it in the garage ready to get into service, he does not have to walk any more than a few bus lengths to get to the next bus he is going to service. This can eliminate time wasted walking as much as several hundred feet and going from inside to the outside which can cause colds and absenteeism in the winter. This parking pattern can save about 1 minute per bus serviced.

All buses to be serviced should be parked together so that forward driving only is required and all the servicing elements should be done in one pass through the service bay. The buses should require moving once only.

Planning and Flexibility - The Maintenance Chief should keep in mind that although servicing is a repetitive operation it is also flexible. He should constantly review road calls for areas of weakness in the servicing system and in the performance he is getting from servicemen. In addition, as the season changes, so should the operations, e.g. in March when streets are slushy, wet and dirty a very slow pass through the bus washer is required while in the summer the buses may well require washing only every second night. On occasions where an operation is not needed, it should be dropped for another which is not required regularly such as checking for loose wheel nuts, tight windows, etc. Some properties check and 'top' torque oil only once a week.

Farebox dumping is generally incorporated as part of the servicing operations, except where buses are left outside for long periods unattended. The farebox man often is a more senior or trusted employee. To the extent that he does not get involved in operations which require him to come into contact with oil, grease and dirt, he is the ideal candidate to do all the recording and generally control the pace and quality of the servicing operations.

Road Calls - The Foreman together with Transportation Department and Equipment Department heads should appreciate that road calls constitute a significant amount of productivity loss, in addition to damaging schedule adherence and system image. Road calls are the direct result of poor inspection, servicing, maintenance procedures, or workmanship. They can also result from driver abuse, lack of rapport between drivers and mechanics and sometimes Transportation Department and Equipment Department officials, or, from wrong choice of bus or poorly built bus.

Good management, supervision and workmanship can control most of the above but this will often bring road calls up to only a reasonably fair level. From there on it takes good driver attitude and good relations between drivers and the maintenance staff to improve performance. This may be enjoyed if there is a good driver training program in effect.

Driver Training - When a driver is hired, ensure that at least one day of his training schedule is spent in the garage where he can be shown: how the buses are serviced, cleaned and checked every night; how tires are changed, grooved or siped and brakes are adjusted to ensure braking is always reliable, also proper braking procedure, skidding, etc., relative to stopping distance and how a Tapley meter will establish when brakes are OK. He should also be shown how engines are tuned and tested for power output - best done on a chassis dynamometer but an acceleration test (against time or distance) will also do the trick. This should include examples of unnecessary abuse such as an engine burned out because it was driven with the red light on (oil or coolant lost) or a broken transmission casing from trying to 'rock' the bus forward and backward when stuck in deep snow, or transmission parts all 'varnished-up' from the driver 'holding' the bus on an incline with the power pedal rather than the brakes.

The new driver must get the message that he will be driving good equipment which is being well serviced and maintained for his benefit. Furthermore, if ever he wants to know what can or can't be done, he should ask the Foreman not the nearest mechanic or garage attendant. Road calls may be reduced by the use of 'Bus Defect Cards'. These are specially designed cards, left in the bus, so the driver can report and record defects or poor performance which are not serious enough to call for a bus change so that they may be attended to before becoming serious.

When it has been established that a driver has been guilty of abuse to the bus or has called repeatedly for bus changes say for poor brakes which have proved OK by Tapley meter test, etc., the case should be passed on to the Transportation Department for (driver) investigation, training and/or disciplinary action.

Performance Indicators

A generally accepted 'target' for servicing is 15 man minutes per bus or four buses per hour per man. To meet this the Equipment Manager and Foreman must exploit every advantage to be enjoyed in good equipment, facilities, planning and training.

For one man, the elements and times to meet the above standard should be approximately:

- start up and drive bus to fueling island (3 min.)
- fuel bus, check oil, water, tires, lights, mirrors, etc., (5 min.)
- clean interior and check outside of bus, etc., (5 min.)
- pass through bus washer (1 min.)
- drive bus to park, and walk to next bus to be serviced (1 min.)

Total 1 man, 15 minutes.

If the duties are split between 2 men then the total time would be 7½ minutes per bus, which again is 15 man minutes per bus.

Questioning Servicing Performance

If this level of productivity in servicing is not enjoyed, the Equipment Manager should examine his operations and visit properties where it is being done. He should question:

- o Do I have all the right automatic equipment? Are my fuel pumps pumping too slowly? (Should be at least 110 L/minute). Are our drivers staging the buses too far from their final park position and creating abnormally long walking distances?

- o Does my servicing operation contain the right elements? Are we doing anything that could be done better as part of another operation, for example, draining air tanks or adjusting brakes, which could be done as part of my safety inspection?

- o Maybe my servicing cycle is sloppy because it is not organized and not done by one group (or man) in one pass through the service bay? How many man minutes extra is it costing us because we have to 'back' buses into parking spaces or drive around a building, etc., to go from 'staging in holding area' to the service bay and to park? What should we do to improve the situation?

- o Have I really given my servicing operations enough thought? After all, almost anybody can do servicing; maintenance is my 'ball game'.

- o It's a funny thing - since we introduced this new 'production line' servicing system, we seem to be having more road calls for poor servicing. Maybe I'd better look in on the operations to see if they are taking short cuts? This system seemed to work so well in the summer but it sure is falling behind in winter. I wonder if our heating, lighting and ventilation could be a factor?

7.4 MISCELLANEOUS GARAGE OPERATIONS

Miscellaneous garage operations includes all the other work and activities that must be done about the garage that are not servicing or maintenance. The staff is normally semi-skilled. Much of their work is repetitive, such as steam cleaning, bus interior cleaning, tire work, traffic control, i.e. placing buses as they return to the garage and 'putting out the service' by assigning buses to drivers. They are also assigned to make bus changes except when a quick simple repair on the road is anticipated or serious mechanical damage is possible. In the winter time this staff is usually responsible for opening and closing doors. On some properties (medium to small) they inspect, service and repair garage and building equipment.

It is not uncommon for one man to be qualified to do all the above duties, particularly on smaller properties. In a medium to large shop this is not necessary but nonetheless convenient. It also reduces the monotony for the worker.

The methods for enjoying productivity in this area of work are very similar to servicing and maintenance. These are:

Work Techniques and Procedures - The application of work simplification techniques to jobs of a repetitive nature, traffic control and parking patterns and providing written procedures and training for these jobs.

The monitoring of steam cleaning and interior bus cleaning is relatively routine and apparent by observation. The Foreman has to be particularly conscious of "foul-ups" in bus parking patterns and assignments to drivers as they can result in buses intended for inspection or work, getting into service by error. Likewise buses returning to the garage with defects that require attention, if not placed according to some predetermined plan, can cause waste motion i.e. not knowing where a certain bus is and then having to move two or three buses to get it out.

Parking and Traffic Control - Have a systematic parking procedure for buses so that they are not moved two or three times to do one operation and/or two buses don't have to be moved to get at the one behind, etc. This is a serious source of lost productivity on most properties. In the medium to large system, traffic control can be quite important to productivity. For example as the buses return to the garage it is desirable to separate those with minor defects, that is, not more than one man hour to fix; major defects, about a half day job; buses that were on trippers; and buses due for steam cleaning, inspections, brake reline, and/or other booked work.

Some systems have their staff start the buses and bring them out to some predetermined point to be turned over to the driver and warmed up in the winter. This may be condoned if it reduces driver's reporting time and allowance or on smaller properties where it helps to round out an eight-hour day for one man. On the other hand it should be kept under strict control to ensure that it doesn't develop into extra work to give a driver his favourite bus.

If garage capacity is overtaxed, say to "crush" capacity (usually considered 10% over design capacity) moving and placing buses, and traffic patterns become difficult and require additional labour for this activity, particularly during winter months.

The Foreman should look in on his bus starter, who assigns the buses to the drivers, every now and then to ensure that this activity is under control. Drivers sometimes appear almost in swarms, all demanding a bus at once. Obviously some of these have reported late and are in a nasty mood. This can create some hostility and confusion which is often taken out on the bus or on maintenance staff.

Performance Indicators

The yardstick for establishing the amount of staff to do all the above may vary but it is generally slightly less than the number of servicemen required, in fact on the smaller property the same personnel often do both the above categories of work.

It is generally appreciated that the larger properties enjoy the advantage of scale for better productivity. The smaller property sometimes suffers the reverse i.e. difficulty finding work for a man, say on the night shift when for safety reasons it is discrete to have two men on shift but the work load could be handled by only one. This is where the Maintenance Chief has to show some imagination and resourcefulness and overcome the problem by utilizing any spare time to some advantage.

As for maintenance, data sources to measure performance come from shop work records, time sheets and budget and cost summaries.

Questioning Performance

The following questions will assist in reviewing how well miscellaneous garage operations are being performed.

- Are our traffic patterns and parking plans effective? Are they being properly observed? Has our bus inspection program been fouled up lately by buses due for inspection not being in when they should be?

- Should we consider outside parking or should we lease some vacant warehouse space (or such) in order to overcome our congestion and difficulties of moving and placing buses in the garage?

- Are we using the best available soaps, detergents and chemicals in our steam cleaning and interior cleaning? Is our steam jenny operating efficiently? How about our pressure spray equipment for interior cleaning? Do we meet the industry "norm" of three buses per man per day for interior bus cleaning?

- Are the drivers generally satisfied with the system and performance employed for assigning buses to them? How many times per month would there be drivers going out late due to oversight or confusion on our part?

7.5 STORES

Stores staff is responsible for the operation, care and security of the storeroom. Their job is to ensure that the Maintenance Department gets the right parts at the right time with no waiting at the stores issue counter. The size of the property will decide to a large extent how this is done, but the organizational system that seems to be most satisfactory is a shared responsibility. That is, the stores (and purchasing) are responsible to the Finance Officer for fiscal and security matters and to the Maintenance Chief for parts supply, issue, quality and inventory levels. In recent years, many systems have been attempting to put their stores operation on the computer. This can reduce clerical errors in posting, initiate purchase orders and assist in controlling and adjusting inventory levels. However it does not necessarily result in better productivity and the output is no more reliable than the input by the stores staff. It can create confusion if not set up properly, or if done in haste and not checked out with the manual system on parallel operation before final conversion.

Like the Foreman and his repair staff, the Supervisor of Stores is the key man to a good stores operation. He should organize his staff so that the following are well organized and performed.

Organization - The stores issue counter should be serviced efficiently with no mechanic delay and no mistaken parts. All materials and tools issued should be properly recorded. Parts should be coded and stored in bins that are well lighted and easily accessible.

Inventory Control - Maximum and minimum inventory levels should be checked periodically to avoid stock-outs. The Stores Supervisor should ensure that his men know the parts by name and sight and work closely with the Maintenance Foreman when campaigns, such as heaters in the fall, are coming up so he can build up his stock of heater parts above normal maximum to provide for the program.

An inventory count of all stock should be made for fiscal credibility once a year. Obsolete stock should be disposed of as soon as possible as it becomes a burden and a loser - and the longer it is held the worse it gets. If no stock-outs is the norm, this suggests that the storeroom is overstocked. The cost of overstocking must be weighed against a lower amount of capital locked up in inventory and the risk of the occasional stock-out.

Facilities - For good productivity, storeroom layout and the location of parts relative to the issue counters is important. Likewise the location of the storeroom should be such that the issue counters are conveniently close for the maintenance workers they serve. The storeroom issue counters should be visible from the Foreman's office. Good lighting and cleanliness are essential. Proper equipment should be provided for lifting, packaging, loading and unloading.

Free-Issue Items - Class 'C' items (generally less than five dollars in value) such as nuts, bolts, washers, etc. should be made available in "lazy susans", at convenient locations about the shop. Where the volume of rebuild work on air and electric units is great enough to keep one mechanic occupied full time at a work bench, the bench should be fitted with 'uprights' about it that have pigeon holes and hooks, etc. to store a week's supply of the many small items used again and again such as connectors, insulators, gaskets, washers, etc. These should be stocked and charged out once a week by a storesman so that the mechanic does not waste his time going back and forth to the stores issue counter to fetch them.

Performance Indicators

There are three indicators which are a good measure of stores performance. These are: 'stock-outs' per month, total worker man hours per day waiting for parts at the stores issue counter and dollars in inventory per bus.

Inventory per bus will be higher for smaller fleets, fleets of higher average age, and where there is not much standardization or the supply and delivery time is not good.

Monthly reports from the Administration Section should be provided to indicate: dollars in inventory by categories (a) bus parts (b) miscellaneous hardware (c) fuels and lubricants, and stock-outs per month.

The Foreman should be aware of any delays at the stores issue counter and instances of a wrong part being issued. These situations cause delays and indicate that the stores staff require training or that the supervision in the stores is lacking. At least once every three months the foreman should make a random count of the number of workers at the stores issue counter and how long they are there. This should be done for a two or three day period. On a good sized property this can add up to the equivalent of one man day per day. It can represent lost productivity on both sides of the issue counter i.e. the maintenance man and the storesman.

Questioning Performance

The performance and productivity of the stores operations and its impact on other garage activities should be under constant review. Questions to consider are:

- Is our training for storesmen adequate? Is there a system for constant upgrading and familiarization for new equipment and new parts? Are we using the newest visual aids for identifying parts?

- Are the daily work assignments for the storeskeepers properly analyzed and assigned? For example, are there storesmen doing other routine duties about the stores room while five or six mechanics are waiting for parts at the issue counter with only one storesman serving them?

- Are we taking advantage of systems used by other transit properties such as; preparing parts kits for jobs in advance; the use of colour coding; plastic bags to identify minimum inventory levels; preferred methods for mounting and holding awkward parts such as large gaskets, tubing, body parts?

- Have we made any special effort to ensure that our information and communications throughout the stores and between stores and maintenance staff is good? Are the stores staff aware of our policy that good quality, heavy duty parts are necessary for a reliable maintenance program?

7.6 BUILDINGS AND PLANT

Plant covers inspection and maintenance of grounds, buildings, garages and garage equipment, janitorial services, bus stop signs and shelters, and snow removal. If not properly managed it can adversely affect the productivity of the maintenance and servicing operations.

The Supervisor of Plant, who usually reports to the Maintenance Chief is also responsible for building heating and ventilation and for the satisfactory supply and efficient use of gas, water and electrical services. On a medium to large sized property Plant is usually a separate department.

Preventive Maintenance - The keys to good productivity in this activity are similar to other maintenance activities, such as good planning to keep staff gainfully employed, preventive maintenance to avoid equipment failure and unforeseen major breakdowns which create an emergency, such as the door to the service bay getting stuck half closed while servicing operations are only partly done. Since the Plant staff is relatively small it is generally desirable not to occupy it all on one large job while other routine work stands still. It may be better to hire contractors who specialize in heating, electrical, overhead doors, roofing, and then only supervision or liaison is required. On the other hand the Plant Supervisor has to have some specialists on staff so that the system does not become paralyzed any time something breaks down, e.g. carpenter, plumber, electrician, stationary engineer 3rd class, etc. Generally one or two men are versatile enough to cover these areas unless a major problem arises.

A weakness which usually prevails in this section is lack of planning and inspection. This is probably because the supervisor of the section is a tradesman who has not received adequate training or thinks planning is not important. If this is not corrected, there can be disastrous consequences because there are so many serious things that can happen to paralyze operations, for example: a broken door or fuel pumping system to stop servicing, broken or leaking hoist pressure system to render unserviceable up to three hoists, snow drifting to block exit lanes or exit doors and delay service going out. Then there is the small construction job which should last a few days but runs into trouble due to poor planning and drags on for weeks.

Emergency Equipment - To avoid these problems, the Supervisor of Plant should have: some emergency equipment such as, pumps, lighting, standby motor-driven

generating unit with sufficient capacity (say 10 to 15 kW for fuel pump and about ten lights), spare springs for overhead doors, and at least one piece of snow removal equipment (say a front end loader with a 3 m^3 bucket). He should also have a list of personnel and contractors (phone numbers) who have agreed to respond to emergency calls.

Annual Work Plan - The major amount of work for the entire year should be planned so that it can be handled with minimum delay and cost. This requires a steady flow of work designed to keep the regular staff employed and for the big jobs to be handled by others. For example, the employment of summer students to clean and paint buildings every second year or so, or to clean up grounds, boilers, etc., can keep the permanent staff free for their normal duties. All the permanent staff should have some special training in skills. Unskilled labour should be hired on a part time basis as required.

It is imperative that none of the work undertaken by the plant staff interrupts the flow of buses. If ever it is necessary to shut off the power, water or gas to change or service some major piece of equipment, the timing should be set so that the disruption or inconvenience to other garage operations is minimal.

Communications - The Supervisor of Plant should maintain good communications with the Transportation and Planning officers for the installation or changing of bus stop signs. This could amount to as many as 50 over a five kilometre route when a significant route change is made overnight or over a weekend. To cope with such demands he should have a truck fitted out to carry all the material required such as poles, signs, fasteners, adhesives, cutters, and diggers, to do this efficiently and effectively. The same applies to shelters and benches, etc.

Performance Indicators

The performance of the Plant Supervisor and plant operations is primarily a measure of how many delays and unnecessary breakdowns occur per year. He has to ask himself if he has resources ready and available to fall back on in event of any emergency. In addition, he has to be prepared to address any possibilities of emergency such as fire (note: fire drills) and safety.

The data sources and monitoring of the buildings and plant activities should come from the final report on the year's operation and from capital expenditures and forecasts.

Questioning Performance

The Building & Plant Supervisor should have in place a process for reviewing his operations and their impact on system productivity. He should question:

- Are there any significant capital projects that should be considered, e.g., building modifications or additions, to improve system productivity? What do the Transportation and Maintenance Departments have in mind in this regard? Do we have a five year projection of capital needs for plant renovations or additions?

- Are we attempting to do work that may cost less or be better done by contractors?

- Are we suffering due to the lack of costly equipment (such as, snow moving and loading) which cannot be justified economically? Have we explored other approaches, say rental, or an agreement to service and maintain the equipment in return for its use?

7.7 SUMMARY

In addition to providing good physical plant, facilities and equipment, the General Manager's role is to create a progressive atmosphere and show evidence of a firm commitment to improve productivity even though he may have to ruffle some feathers in other departments to ensure that the Equipment staff receives the cooperation and assistance it requires.

A major role is played by the Maintenance Chief who is responsible for setting up a comprehensive preventive maintenance and servicing program complete with schedules, methods, and controls. It is his job to see that the Foremen are trained and assisted on "how to manage" so that they may keep their staff gainfully employed at all times. Then there is the "follow through" to ensure that proper planning, training and communications prevail and non-productive labour hours are reduced to a minimum. Finally there is the use of automatic tools and equipment, jigs and fixtures, preferred methods, and other such devices which permit the worker to do a better job in less time. At the worker's level the success of such a program is enjoyed through better working conditions which breed worker interest and enthusiasm.

Workmanship, quality and reliability should also be considered since premature component failure, road calls and repeat work represent labour and material dollars poorly spent and a loss in productivity. The major activities undertaken in a transit garage - maintenance, inspection, servicing and miscellaneous garage operations - together with the support functions of Stores and Buildings and Plant are all candidates for review to determine how productivity may be improved.

Following your systematic Phase I assessment, a report should be prepared. It would list those improvements in your equipment and plant maintenance operation that can be implemented in the short term and those that would be candidates for further assessment in Phase Two.